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F. KLEPETKO.

ROASTING FURNACE.

APPLICATION FILED NOV. 17, 1905.

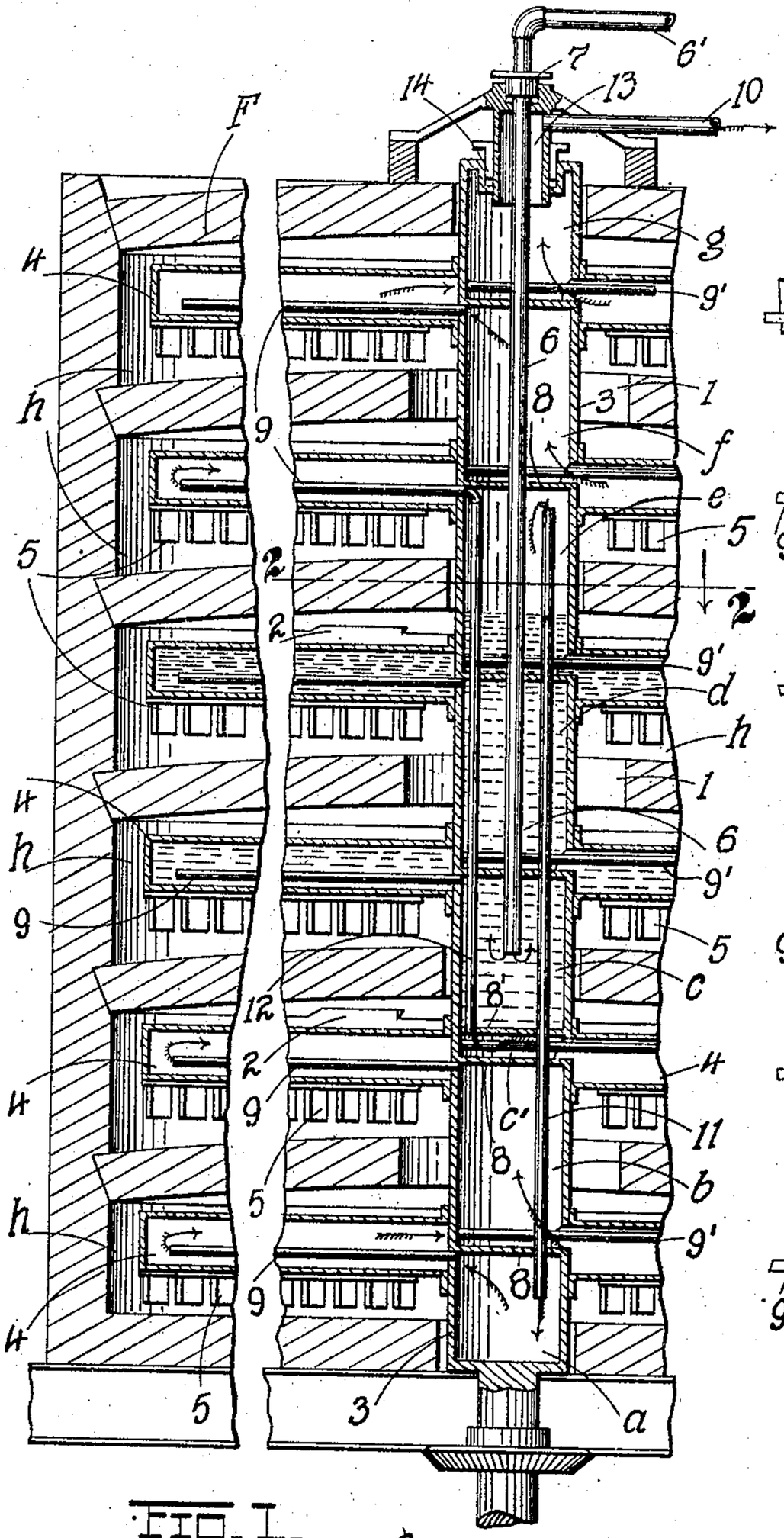

FIG. 1.

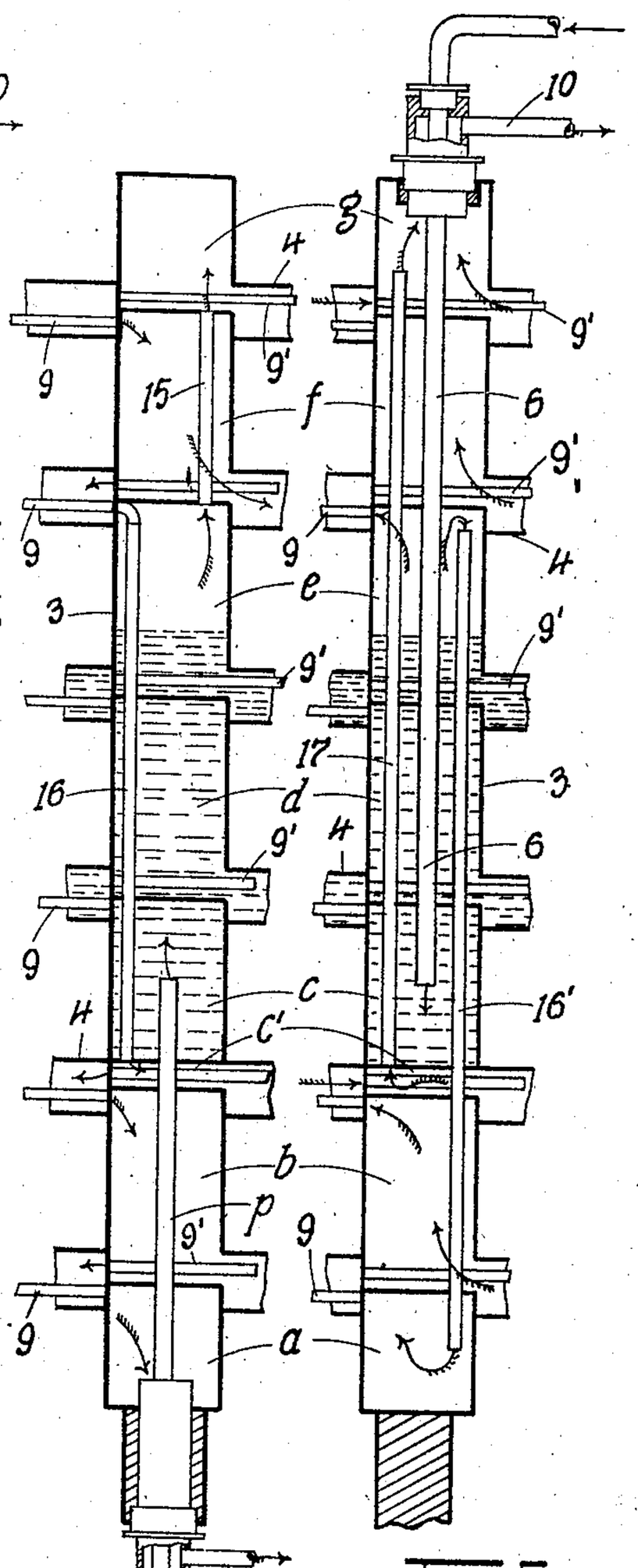

FIG. 5.

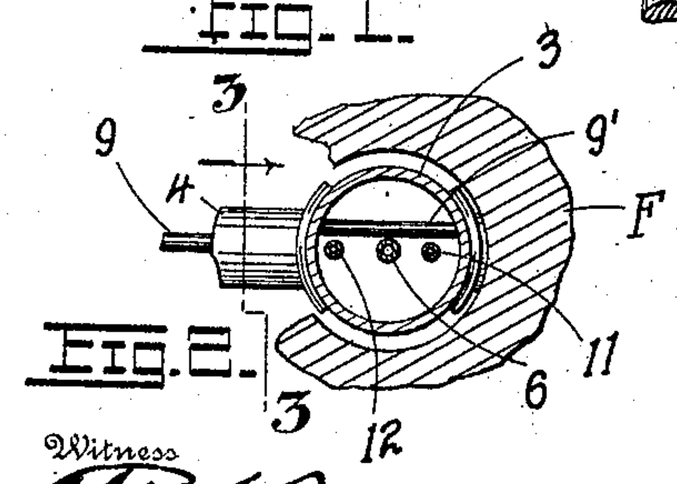

FIG. 2.

FIG. 3.

FIG. 4.

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ROASTING-FURNACE.

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To all whom it may concern:

Be it known that I, FRANK KLEPETKO, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Roasting-Furnaces, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part thereof.

My invention has relation to improvements in rabble apparatus for roasting-furnaces and in the method of cooling the same; and it consists in the novel features more fully set forth in the specification and pointed out in the claims.

In the drawings, Figure 1 is a middle vertical section of a portion of a conventional McDougall ore-roasting furnace, showing one of the forms of my invention applied thereto. Fig. 2 is a horizontal section on the line 2 2 of Fig. 1. Fig. 3 is a vertical section on line 3 3 of Fig. 2. Fig. 4 is a diagrammatic view showing a modified method of circulation through the rabble shaft and arms, and Fig. 5 is a diagrammatic view showing a second modification in the circulating system.

The object of the present invention is to utilize a combination of water and steam as a cooling medium in effecting the necessary reduction in the temperature of the hollow rabble-shaft and rabble-arms used in connection with the turret or McDougall type of roasting-furnace (or, in fact, any type permitting the joint circulation of water and steam through the hollow rabble apparatus) with a view of preserving the rabble apparatus against the destructive and deleterious effects of the gases and high temperature to which these parts are subjected during the roasting operation. The use of water in my present invention is confined to those portions of the rabble apparatus which are identified with the hottest hearths of the series composing the furnace, the steam being used for cooling the remaining portions of the rabble apparatus disposed on either side of the aforesaid hearths. In the turret type of furnace, where there are as a rule in the neighborhood of six or seven superposed hearths, the hottest portions of the furnace are usually confined to the third and fourth hearths. If the rabble shaft and arms identified with these hearths are cooled by water and the remaining portions of the rabble apparatus are cooled by steam, (preferably that generated from the heating of the water employed to cool the first-mentioned portions of the shaft and arms,) not only will a less quantity of water be used than would be necessary were all the hearths cooled by water, but the hottest hearths will be more efficiently cooled than if cooled only by steam. In cooling the hearths of a roasting-furnace the object of course is to abstract as little heat from the charge as possible, so as not to interfere with the operation of effective roasting. At the same time the hearths must be cooled sufficiently to insure against the destruction and deterioration of the shaft and arms used in stirring the charge, and since the use of water alone for cooling all the hearths results with some species of ore in an undue abstraction of heat units from the charge and since the use of steam alone would in some cases result in an insufficient cooling of the rabble apparatus to preserve the same against the high heat of the furnace charge I contemplate by the combined use of water and steam as a circulating and cooling medium results which are eminently superior over the use of either water or steam singly. In referring to the "cooling of the hearths" in the present description what is meant of course is the cooling of the rabble apparatus identified with the hearths, as it is the rabble shaft and arms to which the cooling is directed. The first expression, however, is shorter and is used as a matter of convenience. The advantages of the present invention will better be apparent from a detailed description thereof, which is as follows:

Referring to the drawings, F represents the furnace, and *h* the several hearths in which the material is treated, the said material dropping from the upper hearth successively through the several hearths until it is delivered into the delivery-hopper, (not shown,) the hearths being provided, respectively, with the central and marginal openings 1 2 for the passage of the material. Passing centrally through the hearths is the rotatable hollow rabble-shaft 3, from which radiate the series of hollow arms 4, extending into the several hearths and carrying rakes 5, by which the material is successively fed from one hearth to the hearth immediately beneath it, all as fully understood in the art.

Referring again to the drawings, and par-

ticularly to Fig. 1 thereof, 6 represents a feeder or feed-pipe, (preferably stationary,) which is located within the shaft and extending preferably to a point corresponding to the third hearth from the bottom, there discharging into the shaft, the upper end of the feeder passing through a stuffing-box 7, from which extends the supply-pipe 6′, leading to any source of water-supply. (Not shown.) The shaft is divided into a series of compartments or chambers *a b c d e f g*, the chambers being separated from one another by the transversely-disposed division-walls or partitions 8, occupying a plane slightly above the bottoms of the adjacent rabble-arms 4, each chamber having leading therefrom to one of the rabble-arms a distributing conduit or pipe 9, immediately below or on one side of the partition 8, the said arm communicating with the opposite arm of the same pair or set through a companion or complementary distributing conduit or pipe 9′, extending from a point of the shaft-wall on the opposite side or above the partition 8 and to one side of the feeder 6, Fig. 2. Since the inlet end of the complementary pipe 9′ is directly over the corresponding end of the pipe 9, the former, spanning, as it does, the partition 8, naturally exceeds the pipe 9 in length an amount equal to the diameter of the cross-section of the shaft or the diameter of the partition 8, (where the shaft is cylindrical.) The upper end or top compartment of the shaft is provided with an outlet or discharge pipe 10, the exhaust being conducted to any desired point of consumption. The chamber or division *c* in the present instance is divided into two sections by means of the transverse partition 8′, disposed across the shaft 3 and substantially in continuation of the upper surfaces of the pair of arms 4 in the second hearth, (from the bottom,) the feeder 6 discharging its water into the shaft above said partition 8′ or into the upper section of the said compartment *c*. The lower section of said compartment, for convenience herein identified by the reference-letter *c′*, may be considered as the space between the partition 8′ and the partition 8 immediately beneath. Thus, as shown, the water discharges into the shaft at the third hearth from the bottom. The water so discharged circulates, as shown by the arrows, through the conduit 9, leading from the compartment *c*, into one of the arms 4, extending into the third hearth, thence through conduit 9′ into the second arm of the same set, thence into compartment or chamber *d* and arms radiating therefrom, thence into the chamber *e* to a point substantially above or level with the upper walls of the arms leading from the base of said chamber. The water in the feeder 6 is of course injected in limited quantities, so that it may not completely fill the chamber *e*. Leading from the top of the compartment *e* and passing downward through the several partitions 8 8′ to the bottom compartment *a* of the shaft is a steam-pipe 11, through which the steam generated in the chamber *e* above the surface of the water therein passes downward, discharging into compartment *a* at the bottom of the shaft and circulating through the conduits 9 9′ and arms 4, as indicated, until it reaches the section *c′* of the compartment *c*. From this point the steam passes through a second steam-pipe 12, which leads from said chamber *c′* through the partitions separating compartments *c*, *d*, and *e*. The pipe 12 discharges into the conduit 9, leading from the compartment *e*, whence the steam circulates through compartments *f* and *g*, as indicated by the arrows, the exhaust finally escaping through the pipe 10. The pipe 10 leads from a sleeve or tube 13, enveloping the feeder, the stuffing-box 7 forming the upper end of said sleeve, which is coupled to the roof of the furnace in any mechanical manner. The shaft freely revolves about said sleeve, a suitable stuffing-box 14 being interposed between it and the shaft. The exhaust passes into the sleeve 13, around the feeder 6, and out through the pipe 10, as already indicated, to any suitable source of consumption.

From the foregoing it will be apparent that under my new method of cooling the rabble apparatus the latter is virtually divisioned off into a series of portions or sections, one section for permitting the circulation of water therethrough and the remaining sections circulating the steam generated as a result of the heating of such water, the different sections having intercommunication established with one another by the steam-pipes conducting the steam to the bottom and top of the shaft. By "sections" is herein meant not the specific compartments *a b c d*, &c., but the broad idea of divisioning the rabble apparatus so as to adapt it for the purposes herein contemplated, for it must be apparent that so far as the joint use of water and steam as cooling mediums is concerned the rabble apparatus and the means for circulating the mediums may be constructed in a variety of ways, the specific constructions here illustrated serving only as isolated examples. Thus in Fig. 1 the feeder enters from the top, and the general circulation of the steam after reaching the bottom compartment is upward, the exhaust being drawn off at the top. In Fig. 4 the feeder *p* enters from the bottom, and in this modification I first pass the steam from compartment *e* through a steam-pipe 15 into the top compartment *g* of the shaft, whence it circulates downward into the conduit 9, confined in one of the arms interposed between compartments *e* and *f*, thence through a downtake-pipe 16, leading from said conduit 9 to the space *c′* above the compart-

ment *b*, and thence circulating downward through the compartments *b* and *a* and their hollow arms and conduits 9 9′ out through the exhaust 10′, located at the bottom. Again, in Fig. 5, the feeder 6 enters at the top; but a part of the steam generated from the water in compartment *e* escapes downward through a steam-pipe 16′ into the bottom compartment *a*, circulating upward through compartments *a* and *b* and space *c*′ and passing out through a conducting-pipe 17 into the top compartment *g*, whence it escapes through the exhaust or outlet 10. Another part of the steam passes from the compartment *e* directly through the conduit 9, leading into the adjacent hollow arm, the complementary conduit 9′ then conveying it into the adjacent arm, whence it passes into compartment *f* and from said compartment *f* into compartment *g*, as indicated by the arrows, there to join the exhaust coming from the pipe 17, whence the joint exhausts escape through the pipe 10, so that examples of specific circulations might be multiplied without affecting the principle on which the present invention is based. While the steam which circulates through specified portions or divisions of the shaft and arms is derived from the heating of the water circulating in other portions, yet my invention contemplates any method which produces a circulation of water in one portion of a rabble apparatus and circulation of steam in another portion irrespective of the source whence such steam is derived, the main object being to introduce the water into those portions conceded and recognized in practice to be the hottest. The method of course need not be restricted in its application to roasting-furnaces, but is applicable in any art where cooling is desired.

Having described my invention, what I claim is—

1. In a rabble apparatus, a hollow shaft and hollow arms therefor, means for circulating a liquid cooling medium through a section of the shaft and corresponding portion of the arms, and a vapor of such liquid through the remaining portions of the shaft and arms, substantially as set forth.

2. In a rabble apparatus, a hollow shaft and hollow arms therefor, means for circulating a body of water through a section of the shaft and corresponding portion of the arms, means for circulating steam generated therefrom through another section of the shaft and portion of the arms, and inlet means and outlet means for the circulating mediums, substantially as set forth.

3. In a furnace, a hollow rabble apparatus divided into distinct sections, means for circulating water through a portion of the sections, and steam generated therefrom through another portion, substantially as set forth.

4. In a furnace, a hollow rabble apparatus divided into distinct sections, means for establishing intercommunication between the several sections, means for circulating water through a portion of the sections and means for conducting the steam generated from said water into the remaining sections and circulating the same therethrough, substantially as set forth.

5. A hollow rabble apparatus divisioned off into a series of sections, means for circulating water through one of the sections, means for circulating steam generated therefrom through an adjacent section, and an outlet for the circulating mediums, substantially as set forth.

6. A hollow rabble apparatus divisioned off into a series of sections, means for circulating a body of water through one of the sections, means for circulating steam generated from said circulating body, through an adjacent section, and an exhaust or outlet for the circulating mediums, substantially as set forth.

7. A hollow rabble apparatus divisioned off into a series of intercommunicating sections, means for circulating a body of water through one of the sections, and means for circulating the steam generated from said body of water into an adjacent section and circulating the same therethrough, substantially as set forth.

8. In a furnace having a series of superposed hearths, a hollow shaft passing through the hearths, hollow arms radiating from the shaft and extending into the several hearths, suitable means for dividing the shaft into sections having corresponding arms communicating therewith, means for circulating a body of water through a given section and through the hollow arms corresponding thereto, and means for circulating a body of steam through a section and arms adjacent to the water-section, substantially as set forth.

9. In a furnace having a series of superposed hearths, a hollow shaft passing through the hearths, hollow arms radiating from the shaft and extending into the several hearths, means for dividing the shaft into intercommunicating sections having corresponding arms communicating therewith, means for circulating a body of water through an intermediate section and its arms, and means for conducting the steam generated from said body of water, into an adjacent section and its arms and circulating said steam therethrough, substantially as set forth.

10. In a rabble apparatus, a hollow shaft, series of hollow arms disposed along and radiating from the walls thereof, suitable partitions dividing off the shaft and arms into independent intercommunicating sections, means for circulating a body of water through the central section and its arms, and means for conducting the steam generated from said water into the sections and arms on either

side of the middle section, and circulating said steam therethrough, substantially as set forth.

11. In a rabble apparatus, a hollow shaft and hollow arms therefor, the shaft being divided off into a central section closed at the bottom for retaining a body of water, and adjacent sections adapted to receive the steam generated from said body of water, and means for circulating the water and steam through their respective sections of the shaft and their corresponding arms, substantially as set forth.

12. In a rabble apparatus, a hollow shaft and hollow arms therefor, the shaft being divided off into a central section closed at the bottom for retaining a body of water, and adjacent sections on either side of the central section, pipes for conducting the steam out of said central section to the adjacent sections, and means for circulating the water and steam through their respective sections of the shaft and their corresponding arms, substantially as set forth.

13. In a furnace, a hollow rabble apparatus having distinct cooling mediums circulating through distinct portions of the apparatus, inlet means for said mediums, and a common outlet means, substantially as set forth.

14. In a furnace, a hollow rabble apparatus and means for circulating water through the hotter portions thereof, and steam through the comparatively cooler portions, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

FRANK KLEPETKO.

Witnesses:

MAUDE C. WILLIAMS,

A. F. FULLBERG.